

D-A087 925

NEW JERSEY DEPT OF ENVIRONMENTAL PROTECTION TRENTON F/8 13/13  
NATIONAL DAM SAFETY PROGRAM, TRENTON RESERVIOR (NJ00560), DELAY-ETC(U)  
MAR 80 R WRUBEL DACW61-79-C-0011

UNCLASSIFIED

NL

1 OF 1  
90 3  
10 10

END  
DATE  
FILMED  
9-80  
DTIC

~~LEVEL~~

25

AD A 087925

DELAWARE RIVER BASIN  
MERCER COUNTY  
NEW JERSEY

# TRENTON RESERVOIR

## NJ 00560

PHASE 1 INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM

DACW 61-79-C-0011

DTIC  
ELECTE  
AUG 13 1980



APPROVED FOR PUBLIC RELEASE;  
DISTRIBUTION UNLIMITED.

DEPARTMENT OF THE ARMY

Philadelphia District  
Corps of Engineers  
Philadelphia, Pennsylvania

APPROXIMATE MARCH 1980 RELEASE;  
DISTRIBUTION UNLIMITED

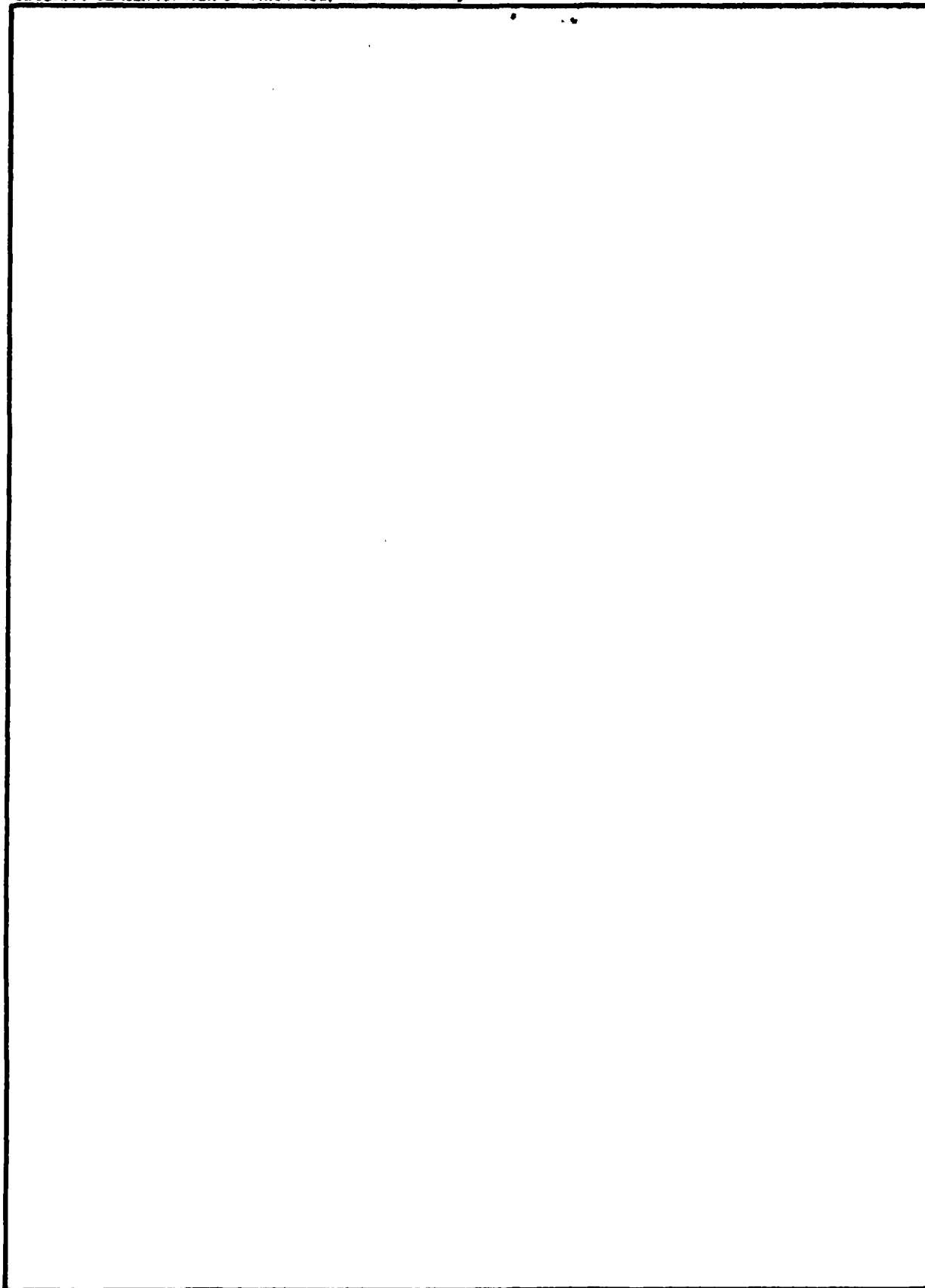
ORIGINAL CONTAINS COLOR PLATES; ALL DOG  
REPRODUCTIONS WILL BE IN BLACK AND WHITE

DDC FILE COPY

80 8 11 187

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NJ00560	2. GOVT ACCESSION NO. AD-A087 925	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Inspection Report National Dam Safety Program Trenton Reservoir (NJ00560), Delaware River Mercer County, New Jersey.		5. TYPE OF REPORT & PERIOD COVERED 9 FINAL Repts
6. AUTHOR(s) RUDOLPH WRUBEL		7. PERFORMING ORG. REPORT NUMBER
8. CONTRACT OR GRANT NUMBER(s) DACW61-79-C-0011		
9. PERFORMING ORGANIZATION NAME AND ADDRESS Louis Berger & Associates 100 Halstead St. East Orange, N.J. 07019		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 11 Mar 78
11. CONTROLLING OFFICE NAME AND ADDRESS NJ Department of Environmental Protection Division of Water Resources P.O. Box CN029 Trenton, NJ 08625		12. REPORT DATE March, 1980
13. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestnut Streets Philadelphia, PA 19106		13. NUMBER OF PAGES 39
		14. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES Copies are obtainable from National Technical Information Service, Springfield, Virginia 22151.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Dams Embankments Structural Analysis Visual Inspection National Dam Safety Program Trenton Reservoir, New Jersey		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.		

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)



SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)



IN REPLY REFER TO  
NAPEN-N

DEPARTMENT OF THE ARMY  
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS  
CUSTOM HOUSE-2 D & CHESTNUT STREETS  
PHILADELPHIA, PENNSYLVANIA 19106

Honorable Brendan T. Byrne  
Governor of New Jersey  
Trenton, New Jersey 08621

05 AUG 1980

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Trenton Reservoir in Mercer County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Trenton Reservoir, a high hazard potential structure, appears to be in stable overall condition and the structural perimeter walls are in excellent shape. There is sufficient additional storage capacity within the reservoir to contain the Probable Maximum Precipitation. To ensure the adequacy of the structure, the following remedial actions are recommended:

a. The following actions should be initiated within one year from the date of approval of this report:

(1) Engineering studies and analyses should be performed to further investigate and evaluate the construction of the embankment.

(2) Evaluate the requirements for an internal alarm system to alert operators of any type of impending failure.

(3) Develop a warning system to alert residents in the surrounding area of an emergency at the reservoir.

(4) Study the feasibility of providing additional emergency drawdown/discharge capacity.

(5) Investigate the wet spongy area near the gate house structure.

b. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the reservoir within one year from the date of approval of this report.

This document has been approved  
for public release and sale; its  
distribution is unlimited.

• **NAPEN-N**

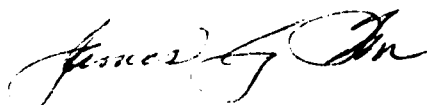
Honorable Brendan T. Byrne

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Thompson of the Fourth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Inspection Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,



JAMES G. TON  
Colonel, Corps of Engineers  
District Engineer

1 Incl  
As stated

Copies furnished:  
Mr. Dirk C. Hofman, P.E., Deputy Director  
Division of Water Resources  
N.J. Dept. of Environmental Protection  
P.O. Box CN029  
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief  
Bureau of Flood Plain Regulation  
Division of Water Resources  
N.J. Dept. of Environmental Protection  
P.O. Box CN029  
Trenton, NJ 08625

Accession For	
NTIS GRA&I	<input checked="checked" type="checkbox"/>
DDC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	<i>for from</i>
<i>SO on file</i>	
By	<i>[Signature]</i>
Distribution/	
Availability Codes	
Dist	Avail and/or special
<i>A</i>	

TRENTON RESERVOIR (NJ00560)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This reservoir was inspected on 16 November 1979 by Louis Berger and Associates, Inc., under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Trenton Reservoir, a high hazard potential structure, appears to be in stable overall condition and the structural perimeter walls are in excellent shape. There is sufficient additional storage capacity within the reservoir to contain the Probable Maximum Precipitation. To ensure the adequacy of the structure, the following remedial actions are recommended:

a. The following actions should be initiated within one year from the date of approval of this report:

(1) Engineering studies and analyses should be performed to further investigate and evaluate the construction of the embankment.

(2) Evaluate the requirements for an internal alarm system to alert operators of any type of impending failure.

(3) Develop a warning system to alert residents in the surrounding area of an emergency at the reservoir.

(4) Study the feasibility of providing additional emergency drawdown/discharge capacity.

(5) Investigate the wet spongy area near the gate house structure.

b. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the reservoir within one year from the date of approval of this report.

APPROVED: *James G. Ton*

JAMES G. TON  
Colonel, Corps of Engineers  
District Engineer

DATE: *22 July 1980*

PHASE I REPORT  
NATIONAL DAM INSPECTION PROGRAM

Name of Dam: Trenton Reservoir Fed ID# NJ00560

State Located New Jersey

County Located Mercer

Coordinates Lat. 4014.9 - Long. 7443.6

Stream None

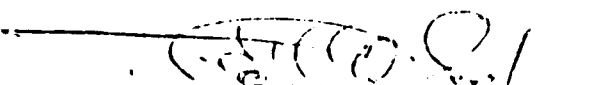
Date of Inspection 16 November 1979

ASSESSMENT OF  
GENERAL CONDITIONS

Trenton Reservoir appears to be in a stable overall condition and the structural perimeter walls are in excellent shape. However, failure could cause significant property damage to surrounding residential and commercial areas and result in a major loss of life. Because no design data is available regarding the embankment, a precise engineering assessment of the long term adequacy of the perimeter cannot be made. Therefore, it is recommended that further engineering studies be undertaken in the future.

Recommended remedial actions include the 1) installation of an internal alarm and community warning system, 2) an evaluation of the outfall valve system in view of the dewatering capabilities, 3) study the feasibility of providing additional emergency drawdown/discharge capacity, 4) an investigation of the wet, spongy area near the gate house structure.

There is sufficient additional storage capacity within the reservoir to contain the PMF design rainfall without overtopping.

  
\_\_\_\_\_  
Rudolph Wrubel  
Vice President  
Louis Berger & Associates, Inc.





OVERVIEW OF TRENTON RESERVOIR

November 1979

## TABLE OF CONTENTS

	<u>Page</u>
Assessment of General Conditions	
Overall View of Dam	
Table of Contents	
Preface	
Section 1 - Project Information	1-4
Section 2 - Engineering Data	5-6
Section 3 - Visual Inspection	7-8
Section 4 - Operational Procedures	9-10
Section 5 - Hydraulic/Hydrologic	11-12
Section 6 - Structural Stability	13
Section 7 - Assessment/Recommendations/ Remedial Measures	14-15

## FIGURES

- Figure 1 - Regional Vicinity Map
- Figure 2 - General Plan
- Figure 3 - Wall Section
- Figure 4 - Floor Plan - Gate House

## APPENDIX

Check List - Visual Inspection	
Check List - Engineering Data	
Photographs	
Check List - Hydrologic and Hydraulic Data	
Computations	A1

## PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT  
NATIONAL DAM INSPECTION PROGRAM  
NAME OF DAM: TRENTON RESERVOIR FED #NJ00560

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

This report is authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with Contract FPM-36 between Louis Berger & Associates, Inc. and the State of New Jersey and its Department of Environmental Protection, Division of Water Resources. The State, in turn, is under agreement with the U.S. Army Engineer District, Philadelphia to have this inspection performed.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the structural and hydraulic condition of the Trenton Reservoir and appurtenant structures, and to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

The Trenton Reservoir is a man-made, four-sided basin with well protected earth embankments and is utilized by the City of Trenton for water storage and supply. Constructed in 1900, the reservoir perimeter is approximately 2,264 feet with the embankment rising roughly 30 feet above the surrounding streets. The interior walls of the reservoir are concrete lined with the top 10 feet of surface having recently been sealed with gunited concrete. A stone masonry core wall surrounds the entire reservoir. The inlet pipe at the east end consists of a 36 inch ascending main supported by a stone pier. The outlets consist of two 48 inch C.I. mains and are located on the west corner.

b. Location

The Trenton Reservoir is located in the City of Trenton, Mercer County. It is bounded on the west by Pennington Avenue (Route 31), on the east by Parkway Avenue, and on the south by Prospect Street and is approximately one mile due north of the State capitol.

c. Size Classification

The reservoir has a maximum depth of 34 feet and a maximum storage capacity of 372 acre-feet. Accordingly, it is placed in the small size category as defined by the criteria in the Recommended Guidelines for Safety Inspection of Dams (maximum impoundment less than 1,000 acre-feet and height less than 40 feet).

d. Hazard Classification

Based on Corps of Engineers criteria and the fact that in the event of a failure, excessive damage could occur to downstream properties together with the potential for loss of more than a few lives, the reservoir impoundment is classified as a high hazard. The reservoir is surrounded by private residences, commercial and office buildings, and is ringed by major highway arteries.

e. Ownership

The reservoir is owned by the City of Trenton, Department of Public Works, P.O. Box 528, Trenton, New Jersey.

f. Purpose of Dam

The reservoir is utilized as an in-city water supply for the City of Trenton.

g. Design and Construction History

The Trenton reservoir was apparently designed and built by personnel of the Board of Public Works in the late 19th century. Details of the initial construction are unknown although a history of the continual upgrading of appurtenances has been recorded by the General Superintendent of

the Water Division of the Department of Public Works. There have been numerous minor operational modifications over the years but no major structural revisions.

h. Normal Operating Procedures

City personnel are on duty on a 24 hour basis. Apart from general maintenance their primary duties consist of the monitoring and control of the water level in the reservoir.

1.3 PERTINENT DATA

a. Drainage Area

Not applicable. All inflow to the reservoir is via transmission lines from the filtration plant on the east shore of the Delaware River. The catchment area = 7.5 acres.

b. Discharge from Reservoir

Maximum discharge capacity of the effluent pipes is unknown and is limited by consumption rates within the City system.

c. Elevation (ft. above MSL)

Top of dam - 144.3  
Normal pool - 139.8  
Effluent piping invert - 95.6 (lower) 120.8 (upper)  
Reservoir bottom - 107<sub>+</sub>

d. Reservoir

Length of maximum pool - 800 feet  
Reservoir perimeter - 2,264 feet ( at coping stone)

e. Storage

Normal design pool - 338 acre-feet  
Top of reservoir - 372 acre-feet

f. Reservoir Surface - 7.5 acres

g. Reservoir Walls

Type - Earth embankment; stone masonry core wall.  
Perimeter - 2,264 feet

Height - 52 feet above foundation (average)  
Height for size classification - 34 feet (height  
from the lowest elevation of the outside barrier)  
Top width - 15+ feet (including 4 foot  
stone wall)  
Side slopes - 2.5-3H:1V (exterior slopes)  
vertical (interior wall)  
Impervious core - unknown  
Zoning - none

h. Diversion and Regulating Tunnel

None

i. Spillway

None

j. Regulating Outlets

2 - 48 inch diameter effluent pipes reduced to  
30" service mains.

## SECTION 2 - ENGINEERING DATA

### 2.1 DESIGN

The information available for review included: Engineering drawings R1-R7 signed by Mr. Chas. A. Hague and dated 1896. These were supplied by the Trenton Department of Public Works. No design computations or details of the valve system/operations were available.

### 2.2 CONSTRUCTION

Information pertaining to the construction or history of this reservoir was not available other than that construction was undertaken in the late 19th century and completed in 1900.

The reservoir is situated along the boundary of the Coastal Plain and Piedmont physiographic provinces. Alluvial deposits of the Pensauken formation comprise the surficial soils with the uppermost four to eight feet consisting of sandy silt, silt, sand and clayey silt with some gravel. Greater depths contain intermixed sand and gravel with some cobbles. The total thickness of alluvium is variable and underlying rock occurs close to or at the ground surface in many areas. However, it appears the walls are not founded on bedrock. The Stockton sandstone formation outcrops in numerous areas north and west of the reservoir. A series of Cambrian and Pre-Cambrian metamorphic rock extends from the Stockton formation east to the Coastal Plain boundary and form a ridge that occurs near the ground surface in the Trenton area. From the ridge line, the rock dips abruptly to the northwest, where it underlies the Stockton formation and dips gently to the southeast where it underlies the Coastal Plain.

### 2.4 EVALUATION

#### a. Availability

In the opinion of the inspection team, sufficient engineering data is available to determine the structural adequacy of the overall embankment although no design computations were located. In addition, no data was acquired upon which to base an assessment with regards to the embankment composition or zoning. However, due to the



masonry core, heavy grass cover and apparently good passive stability over the past 80 years, no urgency exists in acquiring further information.

b. Adequacy

The 1896 contract plans prepared by Chas. A. Hague are considered adequate to assess this dam under the purview of the Phase I inspection and are acceptable without recourse to securing additional information.

c. Validity

The validity of the available design plans is not questioned and based on field observations, the existing overall configuration conforms to the design.

## SECTION 3 - VISUAL INSPECTION

### 3.1 FINDINGS

#### a. General

On-site inspection and conference with the Water Department engineers were held on 16 November 1979.

#### b. Embankment Walls

This pumped storage impoundment is completely surrounded by a four-sided massive embankment with a stone-masonry corewall which is partially exposed on the inner face. The crest terminates in a four foot wide armor cap stone which maintains a 4.5 foot minimum freeboard above maximum reservoir level. The exterior embankment slopes range from 2.5 to 3 horizontal to one vertical and have a continuous well-rooted grass cover. Only at the southwest corner (near the chlorine feed building) was the exterior toe of the slope wet and spongy. This may be attributed to a leak in the 48 inch outfall lines or seepage along their buried concrete encasement.

Although not observed by the inspection team, it is reported that the inside face of the masonry corewall to a depth of 10 feet is parged with a gunite concrete protection.

#### c. Appurtenant Structures

The only ancillary facilities visible are the outlet of the 36" influent pipe which is situated at the top of the east wall and the gate house which houses the outlet valve system/ chlorine room (presently not in use). The 36" ascending main is laid just under the outside embankment surface and is supported by a stone pier/pilaster constructed inside the perimeter corewall. This line is controlled by valves out in Prospect Street.

#### d. Reservoir

The general condition appears satisfactory and no signs of excessive deterioration were noted in view of the advanced age. Vandalism is curtailed by the chainlink fence which completely surrounds the reservoir.

### 3.2 EVALUATION

The primary concern of the inspection team was the structural integrity of the reservoir walls and the hydraulic controls which regulate the water elevation and consequently, the pressures to which the walls are subjected. Except for the previously mentioned minor wetness at the gate house there are no visible indications to question the integrity of the reservoir. The influent and effluent systems are safeguarded against failure with numerous backup valves within the street distribution system. A complete failure of the distribution system would not threaten the stability of the reservoir as the intake system can either be bypassed or cutoff at the filtration plant. The condition or evaluation of the valves and other equipment has little effect upon the safety of the reservoir wall system.

## SECTION 4 - OPERATIONAL PROCEDURES

### 4.1 PROCEDURES

There are city personnel on duty at the reservoir/filtration 24 hours a day. Routine operations consist primarily of regulating the water level in the reservoir, and monitoring flows and pressures in the piping system.

The normal pool was designed and is usually maintained at elevation 139.8 although fluctuations occur during daily operations. The inflow is normally decreased in the morning and usually remains so all day. Water use and piping pressures are monitored and recorded. At the present time all operations in the gate house are conducted manually.

### 4.2 MAINTENANCE OF RESERVOIR

There does not seem to be any posted procedures for inspection or maintenance of the reservoir. It is reported that the reservoir bottom was last cleaned in 1914. The outlet pipes within the embankment were inspected in 1968 as well as in 1975 when the reservoir was inadvertently dewatered due to a malfunction at the filtration plant.

### 4.3 MAINTENANCE OF OPERATING FACILITIES

There does not appear to be a standard periodic maintenance procedure for the operating facilities but such is conducted on an as-needed basis.

### 4.4 DESCRIPTION OF WARNING SYSTEM

There is no warning system in existence at this reservoir which would alert the operators to malfunction or failures in the system or to warn residents in the surrounding area of the possibility of an impending disaster.

Should complete failure of the reservoir and an accompanying flood appear imminent, the only means available to warn and evacuate nearby residents would be the public communications media (radio and television) or possibly the use of roving police patrol cars mounted with public address systems. A subsurface failure could go unnoticed for a long period of time, depending on its extent, since only

a visual observation of a decreasing water elevation in the reservoir would alert the operators to the potential hazard.

#### 4.5 EVALUATION

The present procedures employed at this water storage facility appear adequate for day-to-day operations despite the somewhat aged equipment. However, the lack of periodic and specific inspection procedures, the complete absence of an internal hazardous-condition monitoring system as well as an early-warning public alert system are significant deficiencies with respect to safety procedures (see Section 7).

## SECTION 5 - HYDRAULIC/HYDROLOGIC

### 5.1 EVALUATION OF FEATURES

#### a. Design Data

Water enters Trenton Reservoir either as rainfall over the 7.5 acre catchment area or by the 36 inch influent pipe which comes from the City Water Filtration Plant. Since the influent piping is regulated, only rainfall was evaluated with respect to the hydraulic adequacy of the reservoir.

Although the size of the reservoir is classified as small, the hazard potential is high. A precipitation event equivalent to a PMF was therefore selected to evaluate the hydraulic capacity in accordance with the Recommended Guidelines for the Safety Inspection of Dams. Hydrometeorological Report No. 33 was used to obtain the PMP for this region. When applied to the reservoir, the rainfall would cause a rise in water level of approximately 2.75 feet. Since the reservoir is maintained at a minimum freeboard of 4.5 feet, there is a failsafe freeboard of 1.75 feet, and therefore can accommodate the design storm.

#### b. Experience Data

No history of excessive flows or dangerously high water levels have been reported at this site.

#### c. Visual Observations

All valves function properly according to City personnel. It appears that the walls have never been overtopped, at least in recent times.

#### d. Overtopping Potential

With the equipment functioning as designed, the potential for overtopping appears almost nil. Personnel take periodic readings of the water level in the reservoir. If the level rises above normal operating elevations the flow into the reservoir from the gravity transmission lines can be decreased or shut down entirely either at the check valves on the lines outside the reservoir or at the filtration plant. As indicated above,

the reservoir is capable of containing the amount of rainfall entering the reservoir from a 48 hour PMP event.

e. Drawdown

The discharge pipes are the only means to drawdown the reservoir and their capacity is limited by consumption rates within the distribution system. No meaningful estimate could be made but it is believed it could take several days of normal usage to dewater the facility. Based on the above, additional drawdown capabilities appear to be warranted in light of the high hazard classification.

## SECTION 6 - STRUCTURAL STABILITY

### 6.1 EVALUATION OF STRUCTURAL STABILITY

#### a. Visual Observations

No detrimental evidence was observed to indicate the existence of a serious instability problem.

#### b. Design and Construction Data

Design calculations and the original stability analyses were not available but based on field observations and information obtained from the old plans, the reservoir is founded on a satisfactory subgrade formation. No information is available as to the base of the embankment although it is believed to be about 32 feet wide.

#### c. Operating Records

No records or logs are maintained at this reservoir for operations other than water consumption, transmission line pressure, and water elevations.

#### d. Post Construction Changes

No major changes or additions have been made to the confining structure since its original construction. However, numerous modifications to some of the appurtenant facilities have been reported by city personnel.

#### e. Seismic Stability

The reservoir is in seismic Zone 1 and it may be safely assumed the seismic forces would have only negligible effect on the structural stability. The gravity corewalls are quite thick and partially encased by the concrete fill within the reservoir. Experience indicates that such walls that are stable under gravity loads will also be stable under the effect of earthquake forces.



## SECTION 7 - ASSESSMENTS/RECOMMENDATIONS/ REMEDIAL MEASURES

### 7.1 RESERVOIR ASSESSMENT

#### a. Safety

Trenton Reservoir, which has stood for about 80 years, appears to be sound and adequate and exhibits only a few signs of its advanced age. The reservoir is capable of completely containing a PMP event with a rise in the water level of only 2.75 feet above normal design pool. However, no structural assessment can be made with respect to the stability of the embankments with any added load imposed upon them. Therefore, the present long-term condition remains questionable when inspected within the limitations inherent in the procedures stipulated by the Corps of Engineers.

Operational safeguards exist in the form of backup valve systems which assure standby control of the influent and effluent systems. However, the absence of an independent method of dewatering the reservoir and the lack of a functional overflow system are considerations which would provide additional safeguards against potential hazardous conditions.

#### b. Adequacy of Information

The information available to evaluate the hydraulic and hydrologic capabilities of the reservoir was adequate.

#### c. Urgency

It is recommended that the remedial measures and additional evaluations described should be undertaken in the future.

#### d. Necessity for Further Studies

Further investigations into the condition of the earth embankment, its foundations and manner of construction should be undertaken to determine their applicability with respect to the alert requirements of the surrounding community as well as the need for an internal early warning system within the City Water Engineering Division.

## 7.2 RECOMMENDATIONS/REMEDIAL MEASURES

### a. Recommendations

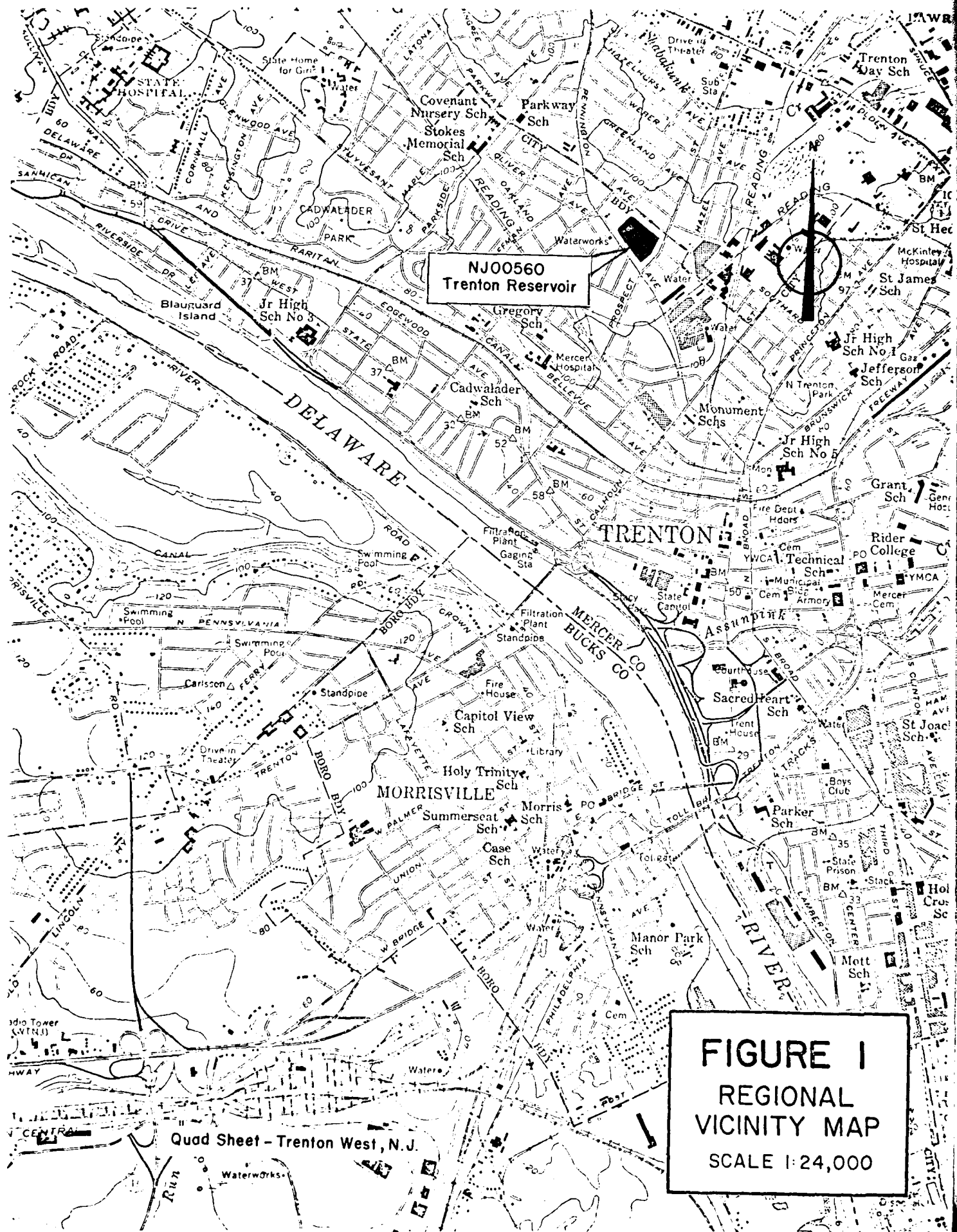
There are several courses of action which should be taken to improve the safety of Trenton Reservoir. As previously stated, further investigation and evaluation of the construction of the earth containment is deemed necessary. The seepage located near the gate house structure should also be investigated.

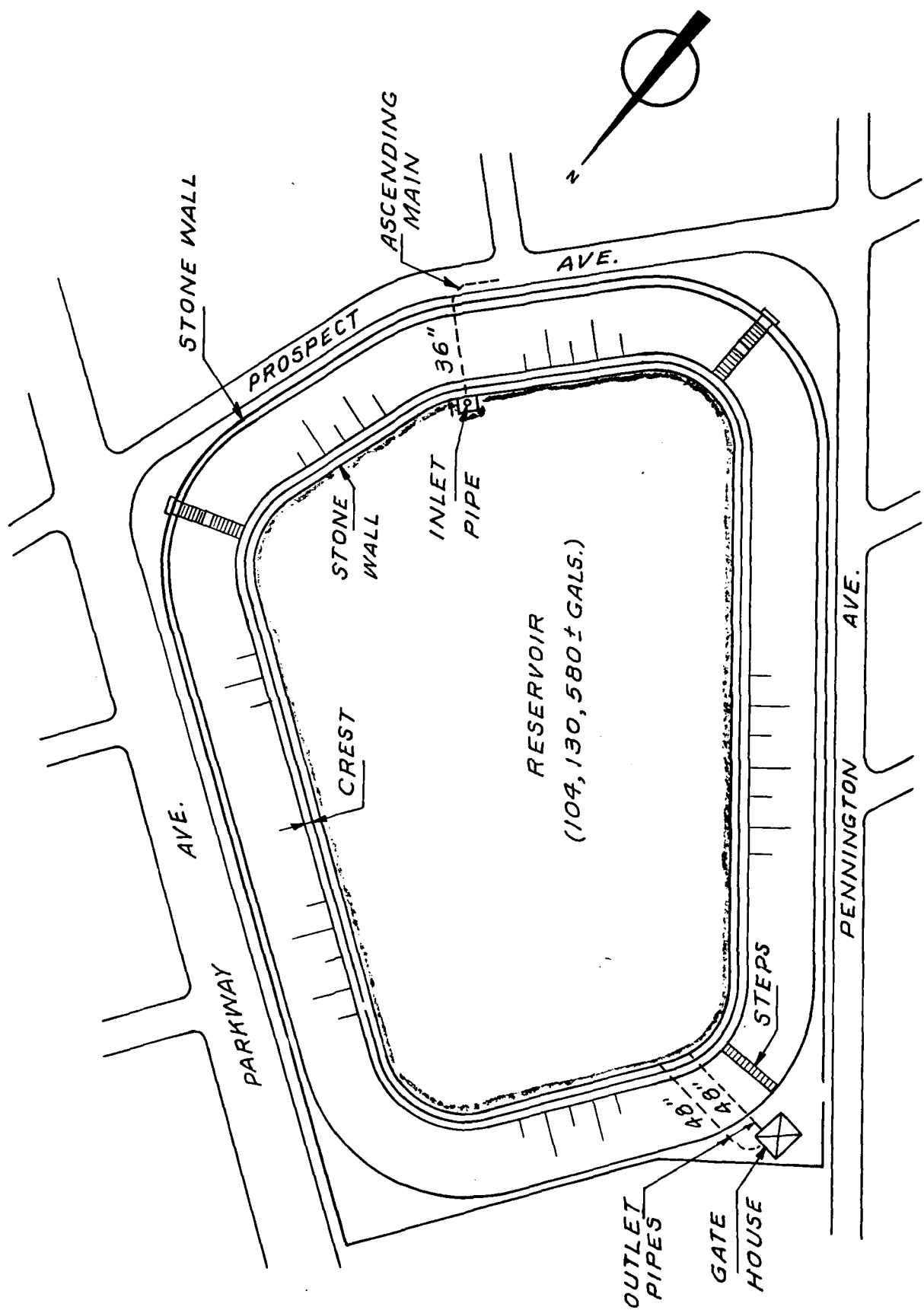
It is further recommended that the City of Trenton evaluate its requirements for an internal alarm system to alert operators of any type of impending failure. The system may take the form of an automatic water level recorder with an alarm to indicate rapid changes in water elevation. In conjunction with an operator's alarm there should be community warning systems to alert residents in the surrounding area of potential hazardous conditions. This may take the form of public address system in conjunction with sirens or roving patrol cars. All systems should be tested at regular intervals and a program should be undertaken to educate nearby residents as to its existence.

It is also recommended that an emergency overflow facility be investigated to provide both emergency drawdown and discharge capacity.

### b. O&M Maintenance and Procedures

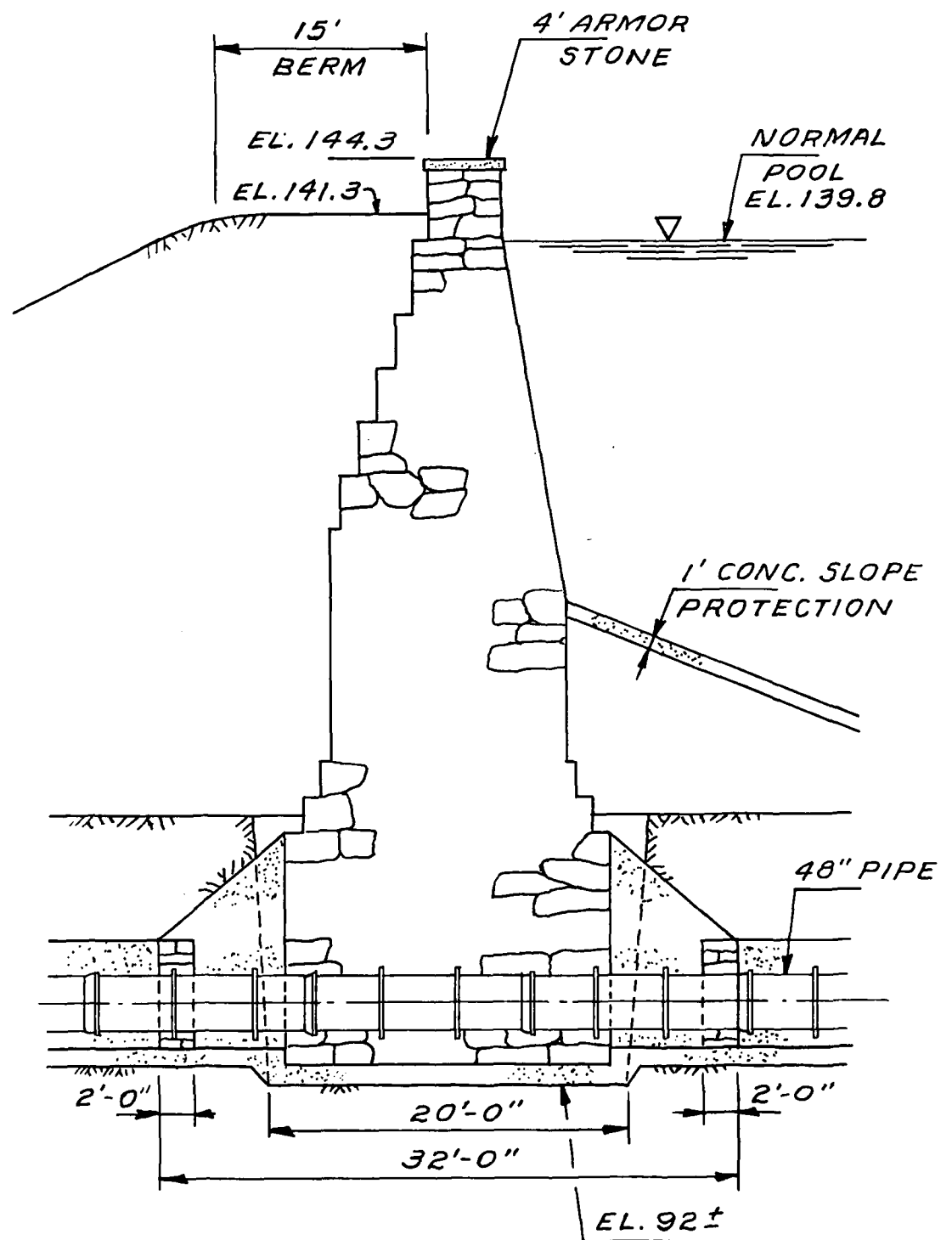
Although present procedures are being diligently pursued in a competent, workmanlike manner, it is suggested that in the near future the owner develop written operating procedures and a periodic maintenance plan to insure the safety of the dam.





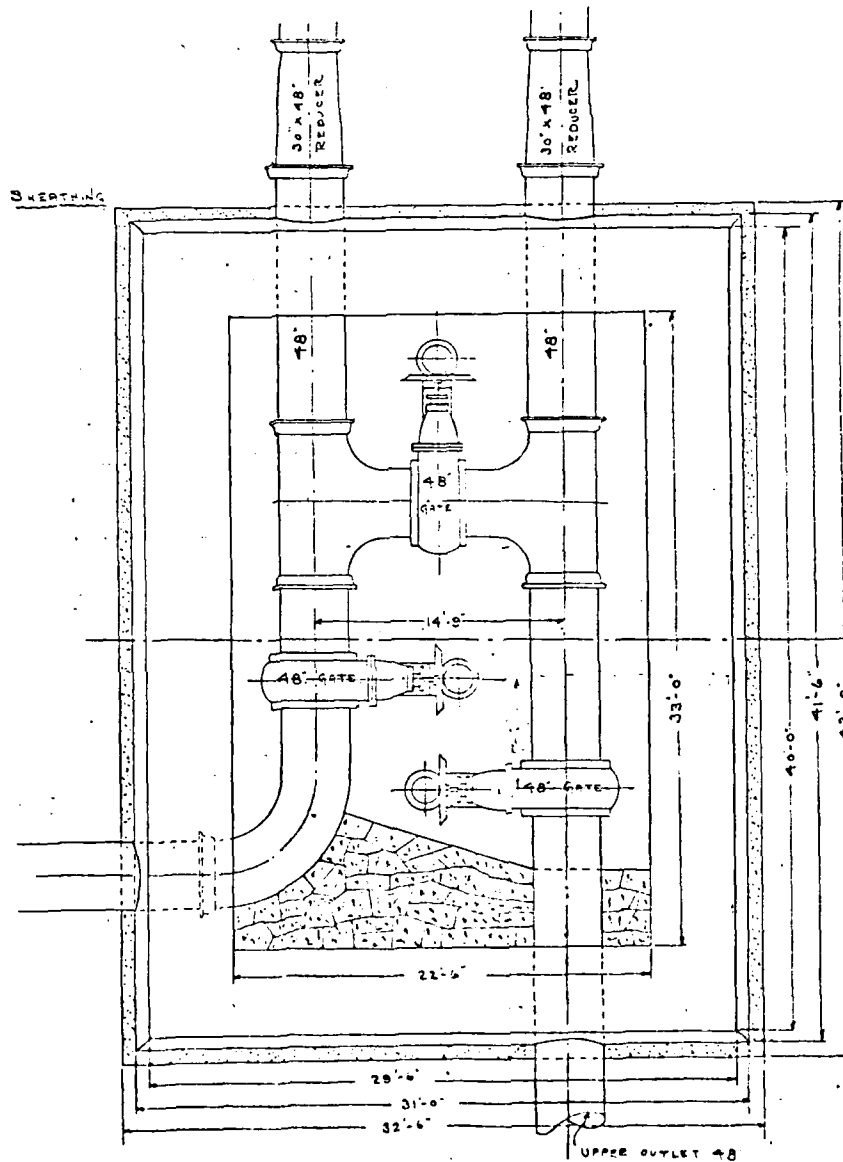
PLAN  
NOT TO SCALE

FIGURE 2



WALL SECTION  
NOT TO SCALE

FIGURE 3



PLAN OF GATE HOUSE  
NOT TO SCALE

Check List  
Visual Inspection  
Phase 1

Name Dam Trenton Reservoir County Mercer State New Jersey Coordinators NJDEP

Date(s) Inspection 11/16/79 Weather Partly cloudy Temperature 50°F

Pool Elevation at Time of Inspection 139.8 M.S.L. Tailwater at Time of Inspection --- M.S.L.

Inspection Personnel:

<u>R. Lang</u>	<u>J. Ceravolo</u>	<u>J. Voorhees</u>
<u>L. Baines</u>	<u>J. Moyle (NJDEP)</u>	
<u>E. Simone</u>		

R. Lang Recorder

Sheet 1

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEE PAGE ON LEAKAGE		
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Wall and embankment are in good horizontal and vertical alignment, appearance of being well maintained.	
SEAMS	None observed	
WATER PASSAGES	Unknown	
FOUNDATION	Unknown, see plans	



CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Minor chipping near inlet pipe.	
STRUCTURAL CRACKING	None evident.	
VERTICAL AND HORIZONTAL ALIGNMENT	Good	
MONOLITH JOINTS	Good	
CONSTRUCTION JOINTS	Good	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	Slopes landscaped with grass and shrubs.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None evident	
SLOUGHING OR EROSION OF EMBANKMENT AND ADJUTENT SLOPES	None, slopes stabilized.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Very good, some small sump holes immediately behind rock walls.	
RIPRAP FAILURES	None, no riprap	

④

Sheet 2

# EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	N/A	
ANY NOTICEABLE SEEPAGE	Possible seepage near toe at gate house. Possibly from cracked pipe.	
STAFF GAGE AND RECORDER	Staff gage located near gate house side of reservoir.	
DRAINS	None	

# OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Buried in embankment. ↑	Condition unknown.
INTAKE STRUCTURE	Submerged	Condition unknown
OUTLET STRUCTURE	Unknown, pipes encased in concrete	Condition unknown
OUTLET CHANNEL	2-48"Ø cast iron pipes	Discharge into City water system.
EMERGENCY GATE	None	

# INSTRUMENTATION

VISUAL EXAMINATION NONUMENTATION/SURVEYS	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
	None	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER	Staff gauge at west end	

RESERVOIR

REMARKS OR RECOMMENDATIONS

OBSERVATIONS

VISUAL EXAMINATION OF

SLOPES

Vertical concrete and stone walls surround reservoir. Approximately 4.5' freeboard.

SEDIMENTATION

None - water pumped in after treatment.

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	N/A	
SLOPES	N/A	
APPROXIMATE NO. OF HOMES AND POPULATION	Many homes & industries immediately below entire reservoir (City of Trenton)	

CHECK LIST  
ENGINEERING DATA  
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Available - City of Trenton, Dept. of Public Works, Water Div.
REGIONAL VICINITY MAP	Available - USGS Quad - Trenton West, New Jersey
CONSTRUCTION HISTORY	None available
TYPICAL SECTIONS OF DAM	Available - Department of Public Works, Water Div.
HYDROLOGIC/HYDRAULIC DATA	None available
OUTLETS - PLAN	Available - Dept. of Public Works, Water Div. Trenton, N.J.
- DETAILS	None available
-CONSTRAINTS	Unknown
-DISCHARGE RATINGS	None available
RAINFALL/RESERVOIR RECORDS	None available



ITEM	REMARKS
SPILLWAY PLAN	Not applicable
SECTIONS	Not applicable
DETAILS	Not applicable
OPERATING EQUIPMENT PLANS & DETAILS	None available

51

ITEM	REMARKS
DESIGN REPORTS	None available
GEOLOGY REPORTS	None available
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None available None available None available None available
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None available None available None available None available
POST-CONSTRUCTION SURVEYS OF DAM	None
BORROW SOURCES.	Unknown

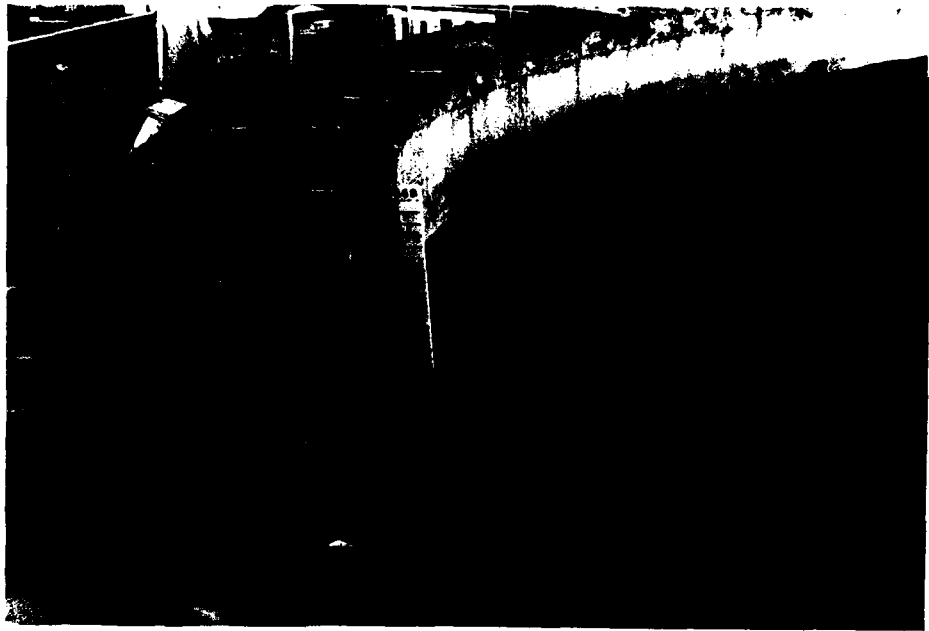
ITEM	REMARKS
MONITORING SYSTEMS	At Filtration Plant
MODIFICATIONS	None
HIGH POOL RECORDS	None available
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None available
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None known
MAINTENANCE OPERATION RECORDS	None available



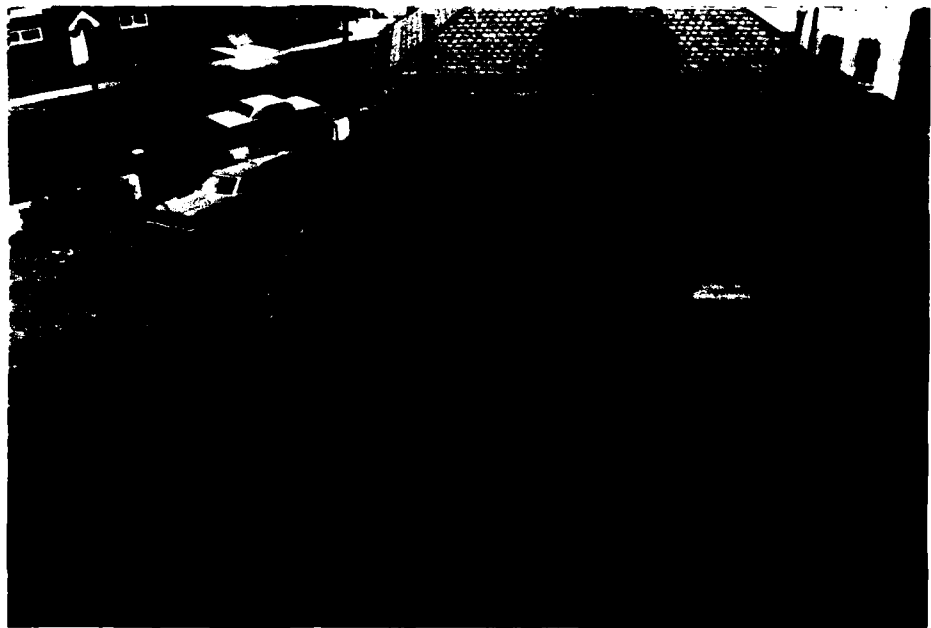
October, 1979  
View of Embankment Along Parkway Ave.



November, 1979  
View of Reservoir Inlet Pipe



November, 1979  
View of Staff Gauge at West End of Reservoir



November, 1979  
View of Gate House at West End of Reservoir

CHECK LIST  
HYDROLOGIC AND HYDRAULIC DATA  
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Not applicable

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 139.8 M.S.L. (338 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): Not applicable

ELEVATION MAXIMUM DESIGN POOL: \_\_\_\_\_

ELEVATION TOP RESERVOIR: 144.3 M.S.L. (372 acre-feet)

CREST: \_\_\_\_\_

- a. Elevation 144.3 M.S.L.
- b. Type Earth embankment with stone masonry core wall.
- c. Width 15 feet
- d. Length 2264 foot perimeter
- e. Location Spillover \_\_\_\_\_
- f. Number and Type of Gates None

OUTLET WORKS: \_\_\_\_\_

- a. Type 2-48" diameter effluent pipe reduced to 30" service mains
- b. Location West corner of reservoir
- c. Entrance inverts \_\_\_\_\_
- d. Exit inverts \_\_\_\_\_
- e. Emergency draindown facilities same as above

HYDROMETEOROLOGICAL GAGES: None

- a. Type \_\_\_\_\_
- b. Location \_\_\_\_\_
- c. Records \_\_\_\_\_

MAXIMUM NON-DAMAGING DISCHARGE: Not applicable  
Discharge governed by consumption rate  
in City Water Supply System.

BY EFE DATE 1/22/57 **LOUIS BERGER & ASSOCIATES INC.**  
 CHKD. BY DATE  
 SUBJECT WATER SUPPLY SYSTEM FOR THE

SHEET NO. 1-1  
 PROJECT 1-45

WATER SUPPLY SYSTEM IS APPROXIMATELY 40% OF TOTAL  
 CAPACITY OF WATER SUPPLY SYSTEM

VOLUME OF WATER ON DAY OF SUPPLY IS QUOTED TO BE  
 $1.0 \times 10^6 = 338 \text{ AF}$

MAXIMUM CAPACITY OF STORAGE IS  $1.0 \times 10^6$  GALL.  
 (2000000 IN SYSTEM)

TOTAL CAPACITY OF STORAGE IS 2000000 GALL.  
 IS 2000000 INCHES

THE 40% OF TOTAL CAPACITY IS 800000 GALL. = 142%

TOTAL CAPACITY OF 40% OF TOTAL CAPACITY IS 800000 GALL.  
 IS 800000 INCHES BY  $1.42 \times 23.5 = 33.4$  INCHES

FLUORIDE 4.5' -  $\frac{33.4}{12} = 1.75$  FT

ACCOUNTING TO BE DONE FOR 100% OF TOTAL CAPACITY DUE  
 TO COMPLETELY UNRELIABLE, THE TOTAL CAPACITY  
 OF THE SYSTEM DUE TO A 40% OF TOTAL  
 EVENTS

TOTAL CAPACITY OF THE SYSTEM IS 2000000 GALL.

IT APPEARS THAT THE TOTAL CAPACITY OF THE SYSTEM IS 2000000 GALL.  
 BY 100% OF TOTAL CAPACITY